

Tillandsia alcatrazensis (Bromeliaceae), a new endemic species from Alcatrazes Island in southeastern Brazil

GABRIEL PAVAN SABINO^{1,4*}, MARCIO DE MELO LEODEGARIO^{2,5}, GABRIEL MENDES MARCUSO^{3,6}, GUSTAVO HIROAKI SHIMIZU^{1,7}, INGRID KOCH^{1,8}, DANILO ULBRICH TAVARES^{1,9} & FÁBIO PINHEIRO^{1,10}

¹ University of Campinas (UNICAMP), Institute of Biology, Department of Plant Biology, Rua Monteiro Lobato, 255, 13083-970, Campinas, São Paulo, Brazil.

² Federal University of Recôncavo da Bahia (UFRB), R. Rui Barbosa, 44380-000, Cruz das Almas, Bahia, Brazil.

³ Instituto Nacional de Pesquisas da Amazônia (INPA), Av. André Araújo, 2936, Petrópolis, 69067-375, Manaus, Amazonas, Brazil.

⁴  gpsabino@gmail.com;  <https://orcid.org/0000-0003-1284-8781>

⁵  ma_r_o@hotmail.com;  <https://orcid.org/0000-0001-9227-0371>

⁶  gabrielmarcuso@hotmail.com;  <https://orcid.org/0000-0002-7520-2876>

⁷  gustavoshimizu@gmail.com;  <https://orcid.org/0000-0002-4731-1311>

⁸  ikoch@unicamp.br;  <https://orcid.org/0000-0003-3256-5922>

⁹  danielotavares73@gmail.com;  <https://orcid.org/0009-0000-2758-7639>

¹⁰  biopin@unicamp.br;  <https://orcid.org/0000-0003-3243-2652>

*Corresponding author:  gpsabino@gmail.com

Abstract

Based on recent field work on an insular granitic outcrop in southeast Brazil, a new *Tillandsia* species was collected and described here. *Tillandsia alcatrazensis* belongs to *T.* subg. *Anoplophytum* and is morphologically similar to *T. geminiflora*, from which it differs by the larger size of the whole plant in flower, larger floral bracts and longer flowers with reddish-salmon sepals and white petals, and longer styles. We present a diagnosis, description, color photographs, illustration, ecological, and phenotypical variation comments, and compares it with the morphologically related species. *Tillandsia alcatrazensis* is preliminarily classified as Critically Endangered (CR) due to its small and restricted distribution, although the Alcatrazes Island is part of a national protected area.

Keywords: Atlantic Forest, Bromeliad, conservation, Poales, saxicole

Introduction

Tillandsia Linnaeus (1753: 286) is a morphologically megadiverse genus and the richest of the Bromeliaceae Jussieu (1789: 49) family with 775 species (Gouda *et al.* [continuously updated]), showing a wide distribution, occurring from the southern United States to Patagonia, in Argentina (Smith & Downs 1977). *Tillandsia* belongs to the subfamily Tillandsioideae and currently, seven subgenera are recognized by: *Aerobia* Mez (1896: 812), *Anoplophytum* (Beer 1854: 346) Baker (1887: 212), *Diaphoranthema* (Beer 1854: 349) Baker (1878: 236), *Phytarrhiza* (Visiani 1855: 340) Baker (1887: 212), *Pseudovriesea* Barfuss & W.Till (Barfuss *et al.* 2016: 46), *Tillandsia* and *Viridantha* (Espejo-Serna 2002: 27) W.Till & Barfuss (Barfuss *et al.* 2016: 47).

In Brazil, the genus *Tillandsia* is represented by 108 taxa, of which 26 species are endemic to the Atlantic Forest (Flora e Funga do Brasil 2023), considered an important biodiversity hotspot for Bromeliaceae (Martinelli *et al.* 2008). Most species in Brazil belong to the subgenus *Anoplophytum*. In the last few years, a relevant number of *Tillandsia* species have been described for Brazil such as *T. nathanii* E.H.Souza & Leme (Souza *et al.* 2022: 99), *T. ertonii* E.H.Souza & Leme (Souza *et al.* 2022: 94), *T. mantiqueirae* Paixão-Souza, N.G.Silva & R.J.V.Alves (Paixão-Souza *et al.* 2021: 198), *T. itatiensis* E.H.Souza & Leodegario (Leodegario *et al.* 2020: 187), most of them from the Atlantic Forest and Caatinga biomes.

During the floristic survey of the Alcatrazes Island carried out by the first author during 2022 and 2023, the new species was discovered and described here. We present a description, a morphological comparison with related species, color photographs and illustration, and provide the preliminary extinction threats assessment.

Material and methods

The new species was found during a floristic survey of the Alcatrazes Island (166 ha), municipality of São Sebastião, São Paulo, southeastern Brazil (Fig. 1). The specimens were collected and pressed following Fidalgo & Bononi (1984) and the herborized material was deposited in PMSP, RB, and UEC herbaria (acronyms according to Thiers [continuously updated]). Some of the individuals collected were kept in cultivation in the living collection of the Universidade Estadual de Campinas (UNICAMP, Campinas, São Paulo state) and were used for the color photographs, illustrations, and description. The photographs were taken from plants in natural habitats as well as in cultivation. The description was obtained from material collected *in situ* and under cultivation, using a stereomicroscope. The data of related species was obtained from original descriptions and from the Flora e Funga do Brasil (2023). The terminology follows Smith & Downs (1977) modified according to Scharf & Gouda (2008) and the new terminology proposed by Barfuss *et al.* (2016).

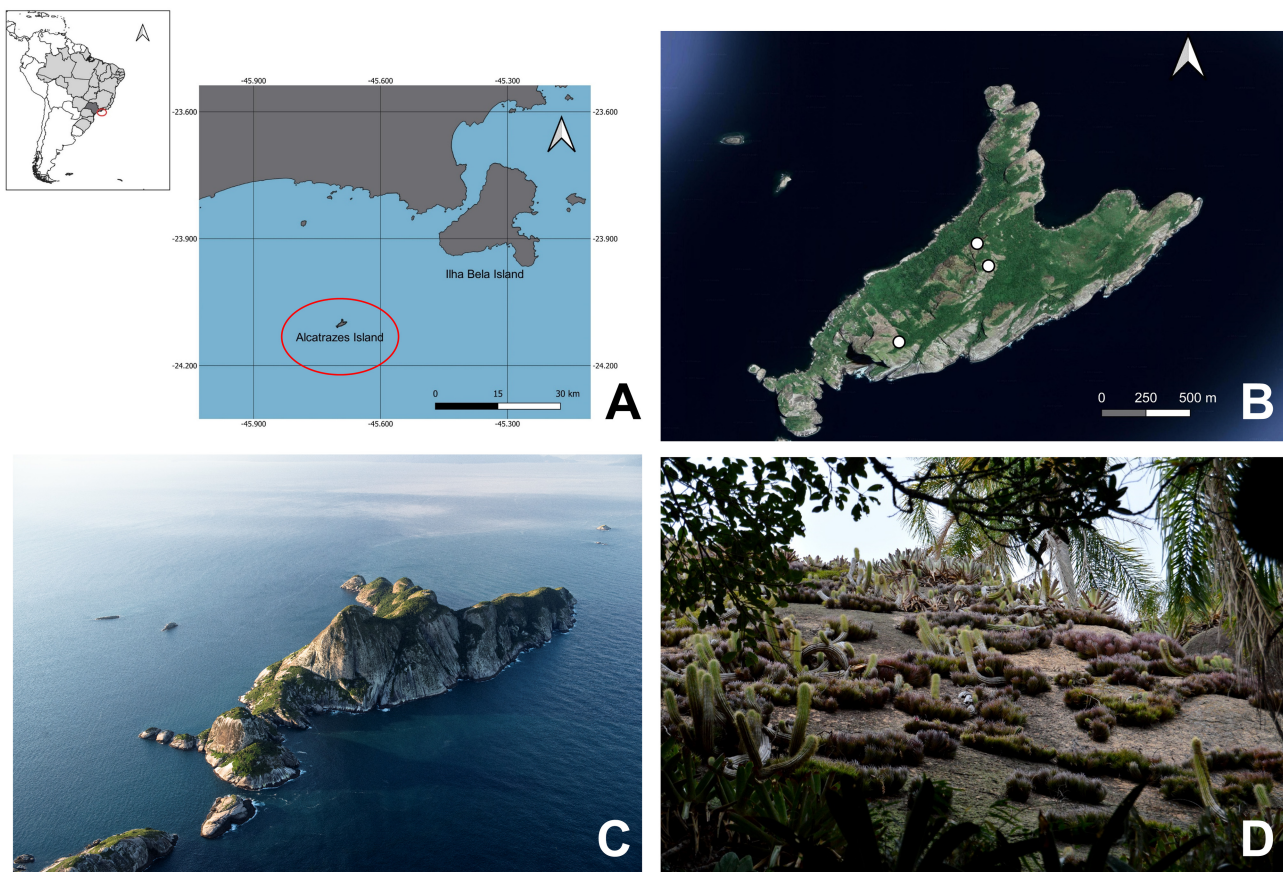


FIGURE 1. Geographical location and habitat of *Tillandsia alcatrazensis* in Alcatrazes Island, state of São Paulo, southeastern Brazil. **A.** South America and Alcatrazes Island location, São Paulo state, southeastern Brazil. **B.** Red dots indicating the collection points of *T. alcatrazensis* on the island (adapted from Google Earth Pro). **C.** Overview of Alcatrazes Island, photo by Luciano Candisani. **D.** Overview of a granitic outcrop where *Tillandsia alcatrazensis* grows together with *Tillandsia cf. araujei* and *Coleocephalocereus fluminensis*, photo by Gabriel Pavan Sabino.

The preliminary conservation status was evaluated following the IUCN Red List criteria (IUCN 2022) and the IUCN Red List Guideline version 15.1 (IUCN Standards and Petitions Committee 2022) based on the geographical distribution of the species. We used the GeoCAT software (Bachman *et al.* 2011) to assess the estimated area of occupancy (AOO) and extension of occurrence (EOO), using the standard values (2×2 km grid cells).

Taxonomic treatment

Tillandsia alcatrazensis Sabino & Leodegario, *sp. nov.* (Figs. 2–5)

Type:—BRAZIL. São Paulo: São Sebastião, Ilha de Alcatrazes, Vegetação rupícola na ascensão da trilha entre o tablado e a base da Marinha (Refúgio de Vida Silvestre do Arquipélago de Alcatrazes), 24°6'1.30"S, 45°41'30.27"W, 207 m, 19 August 2022, *G.P. Sabino, V.A. Kamimura & I.M. Cunha 551* (holotype UEC, isotype RB).

Diagnosis:—*Tillandsia alcatrazensis* is similar to *T. geminiflora*, but is distinguished by, larger size (21–34 vs. 12–20 cm tall), longer floral bracts (1.5–2.5 cm vs. 1–1.6 cm), longer flower (*ca.* 3 cm vs. 1.8–2 cm), longer petals (2.3–2.8 vs. 1.5–1.8), and color (white vs. pink or salmon), longer stamens (*ca.* 17mm vs. 10mm), and longer style (*ca.* 2 vs. *ca.* 0.7 cm).

Description:—**Plant** usually rupicolous or rarely epiphytic, heliophytic, forming clumps. Plants flowering 21–34 cm long, 20–30 cm in diameter. **Roots** present. **Leaves** 8.6–20 cm long, numerous, densely spirally arranged, recurved or ascending, sparsely to densely lepidote on both sides, vinaceous or greenish-cinereous; **sheath** 1.1–4 × 0.9–2.7 cm, narrowly elliptic to obovate; **blade** 7.5–16 × (0.5–)0.7–1.7 cm, very narrowly triangular, apex long attenuately acute. **Peduncle** 11–15 cm long, 2–3.3 mm in diameter, erect or suberect, greenish-orange; **peduncle bracts** 10.9–13.9 × 1.3–1.5 cm, numerous, foliaceous, imbricate, completely covering the peduncle, vinaceous, salmon or pink; **Inflorescence** fertile part 3.5–11.5 × 3.5–10.5 cm, suberect, compound, once branched or rarely twice branched, a globose to pyramidal panicle; **primary bracts** 2.5–8.5 × 1.1–1.7 cm, gradually decreasing in size distally, lanceolate to ovate, attenuate to acuminate, salmon or reddish; **branches** 2–5-flowered, with a sterile terminal flower bud, the lower ones occasionally with a 1–2 flowered secondary branch; **floral bracts** 1.5–2.5 × 0.7–1.2 cm, elliptic, reddish-salmon, lepidote, frequently crenate. **Flowers** sessile, distichous, *ca.* 3 cm long; **sepals** 14–20 × 4–6 mm, symmetrical, lanceolate, apex attenuately acute, free, sparsely lepidote, salmon or reddish; **petals** spatulate, 2.3–2.8 × 0.5 cm, free, the blade spreading to reflexed, apex rounded, white; **corolla** *ca.* 1.4 cm in diameter at the apex. **Stamens** included, *ca.* 17 mm long; **filament** *ca.* 15 × 0.5 mm, plicate, flattened, flaccid, sublinear, whitish, slightly translucent, free; **anther** 2–3 × 0.5 mm, subbasifixed, base and apex acute, yellowish. **Pistil** exceeding the stamens; **ovary** 2–4 × 1–2 mm, greenish to yellowish, ovoid; **style** *ca.* 20 mm long, 0.5 mm in diameter, erect, whitish; **stigma** simple-erect, patent, white; **Fruits** and **seeds** not seen.



FIGURE 2. *Tillandsia alcatrazensis* in habitat. **A.** Growing as a rupicole on rocky substrate of the granitic outcrops, photo by Gabriel Pavan Sabino. **B.** Close up of the flowers, photo by Vitor de Andrade Kamimura.

Etymology:—The specific epithet refers to the Alcatrazes Island, the site where this new species was discovered.

Phenology:—The blooming season spreads into the dry season of southeast Brazil, from May to August. Some individuals were also found blooming in March. Fruits not seen.

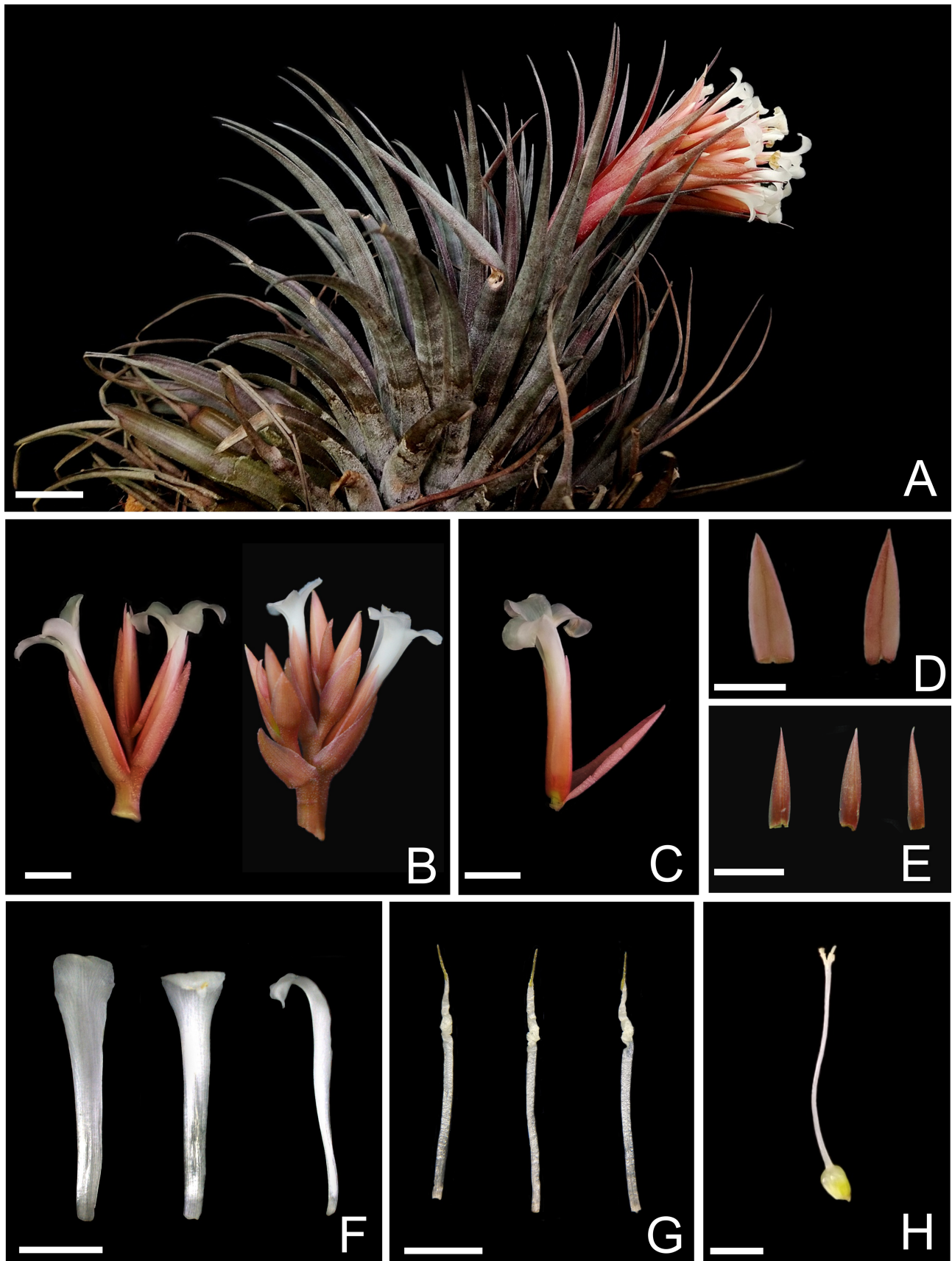


FIGURE 3. *Tillandsia alcatrazensis*. **A.** Habit. **B.** Primary branch (left) and primary branch with a secondary branch (right). **C.** flower with a floral bract. **D.** Floral bracts. **E.** Sepals. **F.** Petals. **G.** Stamens. **H.** Gynoecium. Bars: A = 2 cm; B–C = 1 cm; D = 1 cm; E = 1 cm; F = 1 cm; G, H = 0.5 cm. (Photos by G.P. Sabino based on G.P. Sabino 551, 772).

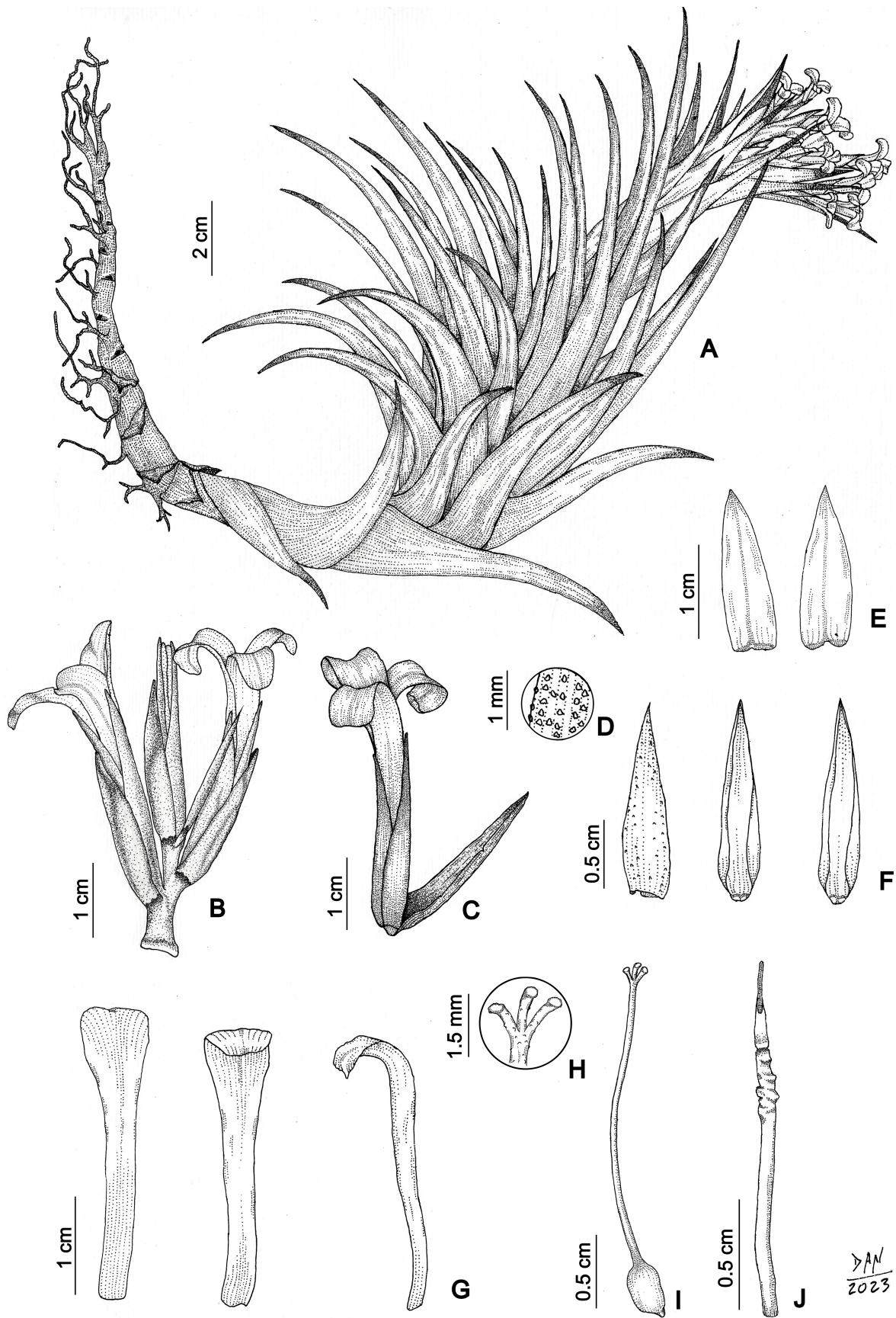


FIGURE 4. A–J *Tillandsia alcatrazensis* (G.P. Sabino 551). A. Habit. B. Inflorescence branch. C. Floral bract and flower. D. Detail of the lepidote sepal. E. Floral bracts. F. Sepals. G. Petals. H. Stigma. I. Gynoecium. J. Stamen. (Illustration by Danilo Ulbrich Tavares).

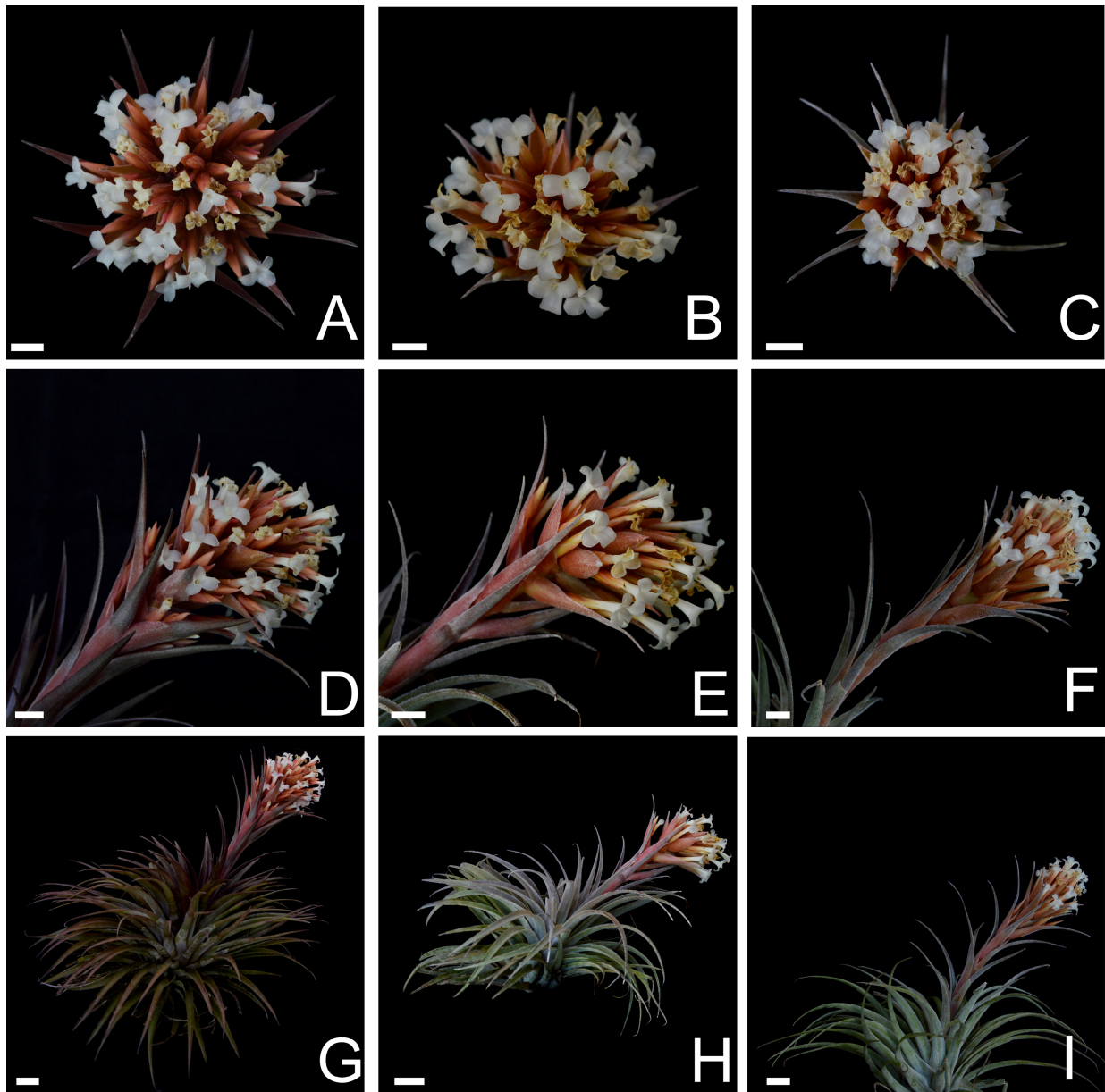


FIGURE 5. *Tillandsia alcatrazensis* phenotypical variation. **A–C.** Front view of the inflorescences. **D–F.** Lateral view of the inflorescences. **G–I.** Habit. Bars: A–F = 1 cm; G–I = 2 cm. Photos by G.P. Sabino based on G.P. Sabino *et al.* 772 (A,D,G), GPS *et al.* 773 (B,E,H) and GPS *et al.* 774 (C,F,I).

Distribution and habit:—Known only from the type locality, growing mainly rupicolous, especially on the top of the granitic outcrops of the island, and rarely as epiphyte in forest patches on the Alcatrazes Island, municipality of São Sebastião, state of São Paulo, southeastern Brazil. The Alcatrazes Island is the main island of an archipelago with the same name, and it is a fully national protected area since 2016 (ICMBio 2020). It is considered an “island of an island” as it is an inselberg-like environment in the Atlantic Ocean, situated 35 km away from the mainland. The landscape of the island is characterized by rocky outcrops vegetation and patches of forest, with influences from the coastal Atlantic Forest of the mainland. The terrain is extremely steep, and there is an Atlantic Forest cover where soil is accumulated. However, on rock outcrops, where the soil is scarce or absent, the forest gives place to shrubby or herbaceous vegetation.

The island is well known for its stunning biota, home of plant species endemic to the island (e.g. *Anthurium alcatrazense* Coelho & Catharino [2008: 830]; *Begonia venosa* Skan ex Hooker [1899: pl. 7657]; *Neoregelia insulana* Leme (Leme & Kollmann 2013: 28), as well as animals (e.g. *Ololygon alcatraz* Lutz [1973: 2]; *Bothrops alcatraz* Marques, Martins & Sazima [2002: 304]). The geographical isolation may limit the gene exchange between insular and mainland populations, increasing the genetic differentiation and reproductive isolation of species found at Alcatrazes Island (Pinheiro *et al.* 2021).

The populations of *Tillandsia alcatrazensis* frequently form densely aggregated specimens, growing on rock, where there is a little organic substrate accumulation or directly on the rock, and in full sunlight. Populations were also found growing on sloping granitic cliffs and rarely as an epiphyte. On the top of the granitic outcrops, where the populations are denser, *T. alcatrazensis* frequently grows together with *Trilepis lhotzkiana* Nees (Arnott 1834: 267), *Anthurium alcatrazense*, *Neoregelia insulana*, *Tillandsia cf. araujei* Mez (1894: 600), *Coleocephalocereus fluminensis* (Miquel 1838: 48) Backeberg (1942: 53), and *Rhipsalis grandiflora* Haworth (1819: 83).

Additional specimens examined (paratypes):—BRAZIL. São Paulo: São Sebastião, Ilha de Alcatrazes, vegetação rupícola na ascensão da trilha entre o tablado e a base da Marinha (Refúgio de Vida Silvestre do Arquipélago de Alcatrazes), 9 May 2022, 24°06'02"S, 45°41'30"W, 227 m, G.P. Sabino, F. Pinheiro, B.L. Arida & W.L.S. Júnior 456 (PMSP, UEC). *Ibidem*, floresceu em cultivo na casa de vegetação da UNICAMP, 23 March 2023, G.P. Sabino, F. Pinheiro, B.L. Arida & W.L.S. Júnior 772 (UEC). *Ibidem*, floresceu em cultivo na casa de vegetação da UNICAMP, 23 March 2023, G.P. Sabino, F. Pinheiro, B.L. Arida & W.L.S. Júnior 773 (UEC). *Ibidem*, na base do Pico da Boa Vista, floresceu em cultivo na casa de vegetação da UNICAMP, 23 March 2023, 24°06'16.75"S, 45°41'47.53"W, 270 m, G.P. Sabino, T.M. Lima & R. Silva 774 (RB).

Conservation status:—The GeoCAT (Bachman *et al.*, 2011) retrieved that the estimated occurrence area for *Tillandsia alcatrazensis* is 4 km². Based on this value and the IUCN categories and criteria (IUCN 2022), we have preliminarily classified this new species as Critically Endangered CR B1ab (i,ii,iii,iv). Illegal collections cannot be ruled out even in a species inhabiting a fully protected area (ICMBio 2020). In 2004, the island also suffered a major fire caused by a Brazilian navy training course, destroying 20 hectares of vegetation and causing the proliferation of exotic plants such as *Melinis minutiflora* Palisot de Beauvois (1812: 54) (ICMBio 2020). This invasive species, in addition to competing with other species, can accumulate dense biomass, which increases the risk of future fires.

Taxonomic notes:—*Tillandsia alcatrazensis* belongs to subgenus *Anoplophytum* by the following features: included stamens, strongly plicate filaments, and slender style much longer than the ovary (Smith & Downs 1977). It is morphologically related to *Tillandsia geminiflora* Brongniart (1834: 186), *Tillandsia gardneri* Lindley (1842: sub t. 63), and *Tillandsia globosa* Wawra (1880: 222); and a comparison with these species is presented on Table 1. In relation to *T. geminiflora*, this new species differs by the main lifestyle (rupicolous vs. epiphytic), its larger size when in bloom, longer flower bracts, longer flower, longer petals and color, longer stamen, and longer style (see diagnosis and Table 1). In relation to *T. gardneri* it differs by the larger size in bloom, longer inflorescence, longer flower, number of flowers per branch, longer floral bracts, longer petal, longer stamen and longer style. *T. alcatrazensis* can also be confused with *T. globosa*, but differs from it by its larger size when in bloom, leaf color, longer inflorescence, longer flower, longer floral bracts, longer petal, longer stamen, and longer style (Table 1).

We observed three other *Tillandsia* species thriving sympatric on Alcatrazes island: *T. gardneri* and *T. cf. araujei* (both of subg. *Anoplophytum*) and *T. usneoides* (L.) Linnaeus (1762: 411) of subg. *Diaphoranthema*.

TABLE 1. Morphological comparison between *Tillandsia alcatrazensis*, *T. geminiflora*, *T. gardneri* and *T. globosa*. Morphological traits, measures and lifestyles were obtained from literature.

Traits	<i>T. alcatrazensis</i>	<i>T. geminiflora</i>	<i>T. gardneri</i>	<i>T. globosa</i>
Lifestyle	rupicolous / epiphytic	epiphytic	rupicolous / epiphytic	epiphytic
Plant height	21–34 cm	12–20 cm	12–25 cm	12–17 cm
Leaf length	8.6–20 cm	6–20 cm	13–25 cm	20 cm
Leaf color	vinaceous, greenish cinereous	green, reddish	silvery	Green
Peduncle length	11–15 cm	15 cm	6–12 cm	6–8 cm
Inflorescence length of fertile part	6.5–11 cm	3–8 cm	4–6 cm	4–6 cm
Flower length	3 cm	1.8–2 cm	1.8 cm	1.8–2 cm
Flowers per branch	2–5 cm	2–4 cm	2–3 cm	2–4 cm
Floral bract length	1.5–2.5 cm	1–1.6 cm	1.2–1.7 cm	1.2–1.5 cm
Sepal length	1.4–2 cm	1.2–1.5 cm	1–1.5 cm	1.2–1.5 cm
Sepal color	reddish-salmon	pink	pink	pink
Petal color	white	pink-salmon	pink	pink to white
Petal length	2.3–2.8 cm	1.6 cm	1.4–1.8 cm	1.5–2.2 cm
Stamen length	1.7 cm	1.0 cm	0.9 cm	1.1 cm
Style length	2 cm	0.7 cm	0.8 cm	0.6 cm

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